

by STATINTL

Eddie N. Bernard, Lt. (jg), NOAA Corps

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I. Introduction

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This report describes my participation in the Scientific Exchange Program under the US/USSR Agreement on Environmental Protection as outlined during the first meeting of experts of the US/USSR on Integration of Tsunami Warning Systems held 2-7 December 1974. (A copy of the record of discussion is included at the end of this report.) My contribution to the program was to perform numerical hydro-dynamical computations of tsunamis interacting with the Kuril Islands at the Siberian Computer Center in Novosibirsk, USSR. The length of my visit was from 3 July to 15 August 1975. From 3 July to 7 July I was in Moscow discussing the objectives of my visit to Novosibirsk with S. L. Soloviev and V. M. Popov. This report describes the meetings in Moscow, as well as my visit to Novosibirsk. In particular, the objectives that were accomplished, the exchange we received from the Russians, the working and living conditions, the treatment by the hosts, and my personal conclusions will be discussed.

II. Moscow Meeting

My wife, Shirley, and I arrived at the Moscow airport on 3 July where we were met by a colleague of S. L. Soloviev. This gentleman escorted us to the Hotel Warsawa and established a meeting with Professor Soloviev, V. M. Popov, V. K. Gusakov, Y. E. Kazakov, and an interpreter at the Hydrometeorological Headquarters.

The first part of the meeting was concerned with clarifying several points about the expedition off the Kuril Islands commencing 1 August 1975. Since I could not answer some of the questions, I telephoned G. R. Miller of the Joint Tsunami Research Effort, Honolulu to resolve the problems. Specifically, I relayed the following questions for V. M. Popov.

- 1) Of what country is D. Y. Shinmoto (an assistant of R. R. Harvey during the expedition) a citizen?
- 2) What is the itinerary of R. R. Harvey after the expedition?
- 3) When will Dr. G. R. Miller arrive in Sakhalin?

Also, three changes made by the Soviets were relayed.

- 1) The Soviet ship was to remain at sea from 1 August to 30 September 1975 around the southern Kuril Islands.
- 2) The Soviets requested that Dr. Harvey remain aboard ship until 30 September to handle the instrumentation and equipment of the expedition.
- 3) The Soviets requested an instrumentation list for equipment brought into the USSR.

EL-E Earthquake Prediction (0309)

The second part of the meeting concerned the joint project. Professor Soloviev explained that a large tsunami had occurred in the southern Kuril Islands on 20 June. He, therefore, wanted the project to emphasize this portion of the island chain. I showed the members of the committee a preliminary model I had programmed in Honolulu. Figure 1 shows the area modeled and the grid size, while Figure 2 shows the discretized form of the model with an initial disturbance in the center. The data from which I created the gridded bathymetry was from H.O. chart 96000. This chart, however, is of low resolution (especially close to the islands), so I therefore requested a more detailed set of charts would be available in Novosibirsk. Next we went over the list of objectives I hoped to accomplish during my six weeks in Novosibirsk. (This list is located on page 6.) All members of the committee agreed that these objectives should be pursued. Professor Soloviev added that he wanted any results from this work to be published jointly by the US/USSR.

The third part of the meeting was concerned with my living in Novosibirsk. I was given 400 rubles (40 days per diem) and was told the Soviet government would pay for my accommodations. I would, however, have to pay for all my wife's expenses. To this I agreed and the meeting was closed.

V. K. Gusakov, who attended the meeting as a representative of the Siberian Computer Center in Novosibirsk, acted as our host in Moscow. He guided my wife and I around Moscow and took us to the Moscow Circus and the ballet at the Palace of Congresses within the Kremlin. On 7 July he escorted us to Novosibirsk on Aeroflot Airlines.

At the suggestion of Dr. W. Brown on the State Department, I contacted the U.S. Embassy in Moscow on 4 July. I talked briefly to Egon Loebner, Science and Technology Specialist, about my visit and objectives of the joint project. I gave him the address and telephone number of the Siberian Computer Center. Upon my return from Novosibirsk on 15 August, I again contacted him and informed him of the details of my visit to Novosibirsk.

III. Novosibirsk

The easiest way to summarize the events of the six weeks in Novosibirsk is to explain certain areas in detail. For clarification, the scientific community of Akademgorodok, located 30 km from Novosibirsk, was the location of the Siberian Computer Center. It was in this small community that we stayed for six weeks. To avoid confusion, whenever Novosibirsk is referred to, it is actually Akademgorodok. The following breakdown can be read in sections or in entirety as each section is independent of the others.

A. Accomplishments

A simple way to discuss the accomplishments is to refer to the list of objectives on page 6. The number of objectives will correspond to the numbers of explanations below.

- 1) Two numerical models simulating tsunamis in the Kuril Islands were run on the BESM-6 computer at the Siberian Computer Center. The first model was a duplication of the model run in Honolulu. This served as a test between the IBM 370/65 and the BESM-6 for accuracy, execution time,

and as a check on the program modifications. The BESM-6 is one-tenth as fast as the IBM 370. CIA RDP79A001000100013-2
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The storage limitation required some modification in the original model, but by 17 July we had the model running on the BESM-6. The next logical step was to begin construction of the southern Kuril Island model. This required the acquisition of higher resolution bathymetric charts that were promised in Moscow. Not until 5 August did we receive such charts which entailed working many extra hours to have the southern Kuril Island model before 15 August. We were successful and the second Kuril model is shown in Figure 3. This model has a 2.5 km grid with 4488 grid points representing the area of Shakata, Kunashu, and part of Hokkaido.

During the interlude of 17 July and 5 August, we worked on the initial condition problem for locally generated tsunamis. A numerical model of tsunami generation created by V. K. Gusakov and A. S. Alckseev provided us with the sea surface deformation created by an underwater earthquake. We tested various types of earthquake parameters such as orientation with respect to the Kuril Trench, magnitude, and initial earth displacement. Finally, we chose a 100 km vertical dip-slip fault oriented parallel to the Kuril Trench in the same geographical position of the 20 July 1975 tsunami. Using the sea surface deformation at a time 50 seconds after the earthquake occurred provided us with the initial condition for the tsunami interaction models.

- 2) The models were not actually used to help design the field experiment because the tsunami of 20 June gave a stronger indication of tsunami activity. The emphasis was on the southern Kuril Islands without the aid of the numerical models.
- 3) The models were used to describe response characteristics to locally generated tsunamis. The output from the codes which I ran are now being compared with actual observations in the Kurils. There was not enough time to consider remotely generated tsunamis.

- 4) A five-minute 16 mm movie of the Siberian Computer Center facilities and the people with whom I worked was filmed by V. K. Gusakov. This film will be brought to the Joint Tsunami Research Effort by Gusakov when he comes to Hawaii.

Not enough work was accomplished during my six week's visit to merit a publication. The beginnings of a detailed tsunami study were initiated and hopefully interest will emerge from both sides to follow through.

B. Exchange

I returned the following to JTRE in honolulu.

- 1) V. K. Gusakov's program of water suface deformation description by the generating underwater earthquake (This program provides initial conditions for present numerical tsunami models and provides a tool for examining different types of tsunami sources.)
- 2) Bathymetric data used in the southern Kuril Island model (This data will be useful in creating future models of the area. Since the Kurils have a high occurrence of tsunamis, it is a potential model area to compare models to nature.)

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by Y. I. Shokin and L. E. Chebarov (This program will be useful in comparing linear vs. nonlinear modeling.)

C. Working Conditions

- 1) Many people, fortunately, at the Siberian Computer Center spoke fluent English since neither my wife nor myself spoke any Russian.
- 2) I was assigned a large office close to the library. L. E. Chebarov and V. K. Gusakov assisted me in learning the use of the BESM-6 and in utilizing the other facilities. L. E. Chebarov was instrumental in helping me overcome the program changes. Without his dedication, I probably would not have been able to make the models work.
- 3) The largest problem I faced in my six week exchange was the turn-around time of the BESM-6 computer. I average two runs a day while at Novosibirsk. This slow return from the computer severely retarded the debugging of programs and execution of running programs.
- 4) The second largest problem was the keypunch machines. These machines punched a binary code along a row instead of a column (like IBM) and printed no symbols on the card itself. To verify the card punched, one had to punch a second card as a check. If the two cards matched, one assumed they were correct; if not, one assumed one card was mispunched. Since nothing was printed on the card itself, it was difficult to insert a card in the proper place in the deck. To avoid positioning problems, one had to number the cards.
- 5) The Siberian Computer Center has a Benson plotter but, while I was there, there was no working software to make plots. For this reason, the output from my models had to be plotted by hand.

In conclusion, the people were very helpful and willing to work extra hours to get the project completed, but the computer system had several technical disadvantages which impaired our progress.

D. Living Conditions

My wife and I lived in a two-bedroom furnished apartment similar to those of the other scientists living in Novosibirsk. The apartment was equipped with a refrigerator, radio, and television. The community was located 2 km from the shores of the Ob Sea (a large lake) which provided a resort atmosphere. Also, the community was built within a forest so hiking trails were abundant. There were two restaurants, a movie theater, and bars for entertainment.

My wife, who has a Bachelor's degree in education, was asked to teach a conversational English class. She held a 3-hour session each day for four weeks to help the scientists at the Computer Center become more fluent in English conversation. Her class of ten students enabled her (and, as a result, me) to get much closer to the scientists there.

E. Treatment by Hos

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The people we worked with were very hospitable. We were invited into the homes of Y. I. Shokin and V. K. Gusakov. We went on some excursions together and enjoyed their friendship immensely. We were taken to a film festival, an art show, a ballet, and several banquets. A Russian picnic on an island in the Ob Sea proved to be an unforgettable experience. V. K. Gusakov helped us with problems of living in Novosibirsk. His patience and efforts made our stay much more enjoyable than if we had had to depend on our Berlitz!

F. Conclusions

I feel that the visit to Novosibirsk was successful in executing what we originally planned. We accomplished the important objectives and learned valuable information about the BESM-6 system. I feel that future trips, where American numerical modelers might go to the Siberian Computer Center, should only be taken realizing that the facilities available are less advanced than most modern US facilities. From my experience at other US computer facilities (especially the National Center for Atmospheric Research), it is apparent that more work could be accomplished with less time and effort at a US computer facility. My suggestion is that the Russians bring their tsunami data (bathymetric, runup, and other pertinent data) to one of our computer facilities and do the numerical modeling on US machines. The time and expense saved by not having to convert an existing program to fit the BESM-6 could be used to do more of the problem. The exchange could be to introduce the codes running on US machines to the Soviets and let them return with programs they could modify for their machines. In this manner, all the time spent by US experts will be in solving the scientific problem, not in learning about a computer system 5-10 years old.

I also feel that the opportunity to participate in this exchange program has been one of the greatest experiences of my life (my wife's also). I learned great respect for the hardworking Russian people I associated with and I hope that exchange programs similar to this one continue to exist so that both countries can work together to solve mutual problems. Certainly in the area of tsunamis, the Russians have much to contribute in a scientific understanding of the problem.

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Objectives of Visit

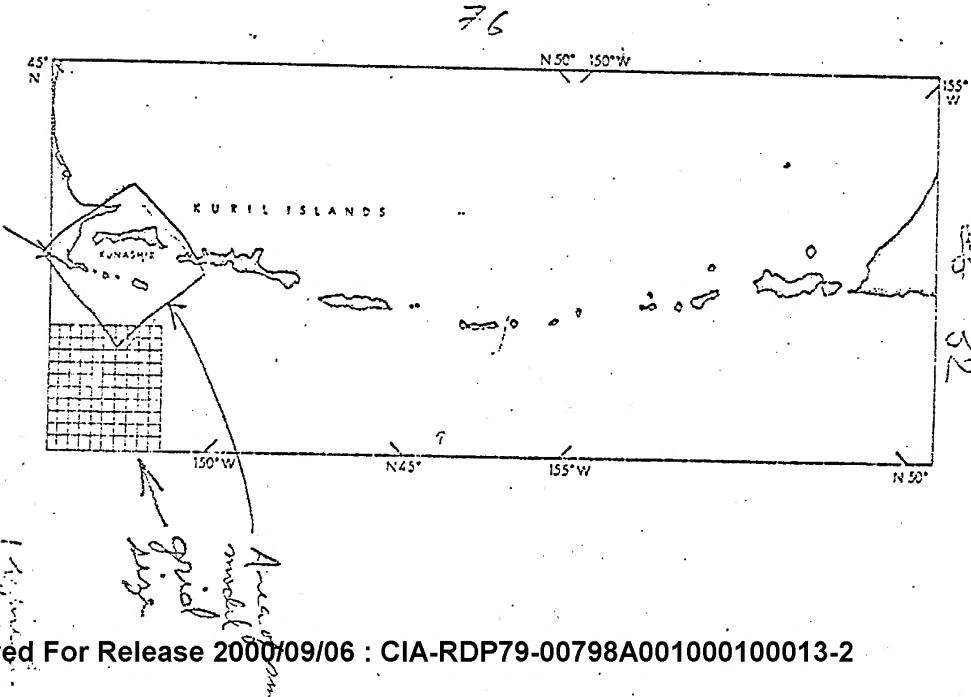
- 1) To conduct research utilizing numerical hydrodynamical models especially of the Kuril Islands on the BESM-6 computer at the Novosibirsk Computer Center, USSR
- 2) To use the models to determine tsunami characteristics within the island system to aid in the design of the field experiment to be conducted in August 1975
- 3) To use the model to determine response characteristics of the Kuril Island system to locally and remotely generated tsunamis
- 4) As a second priority task, to document photographically (16 mm) this portion of the Cooperative Tsunami Research Project for use in a movie of the entire project

Responsibility of Executing Objectives

Objectives 1, 2, and 3 will be carried out by E. N. Bernard on the BESM-6 computer in Novosibirsk, USSR. He will work cooperatively with the staff of Professor A. S. Alekseev, Director, Siberian Computer Center. Objective 4 may be carried out with assistance from photographers at the Siberian Computer Center with the understanding that the film will be used as part of a documentary film of the entire project. The Joint Tsunami Research Effort will compile the movie and give copies to each component involved in the Cooperative Research Project. Plus, a result of calculations will be published jointly for both the USSR and US.

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Figure 1



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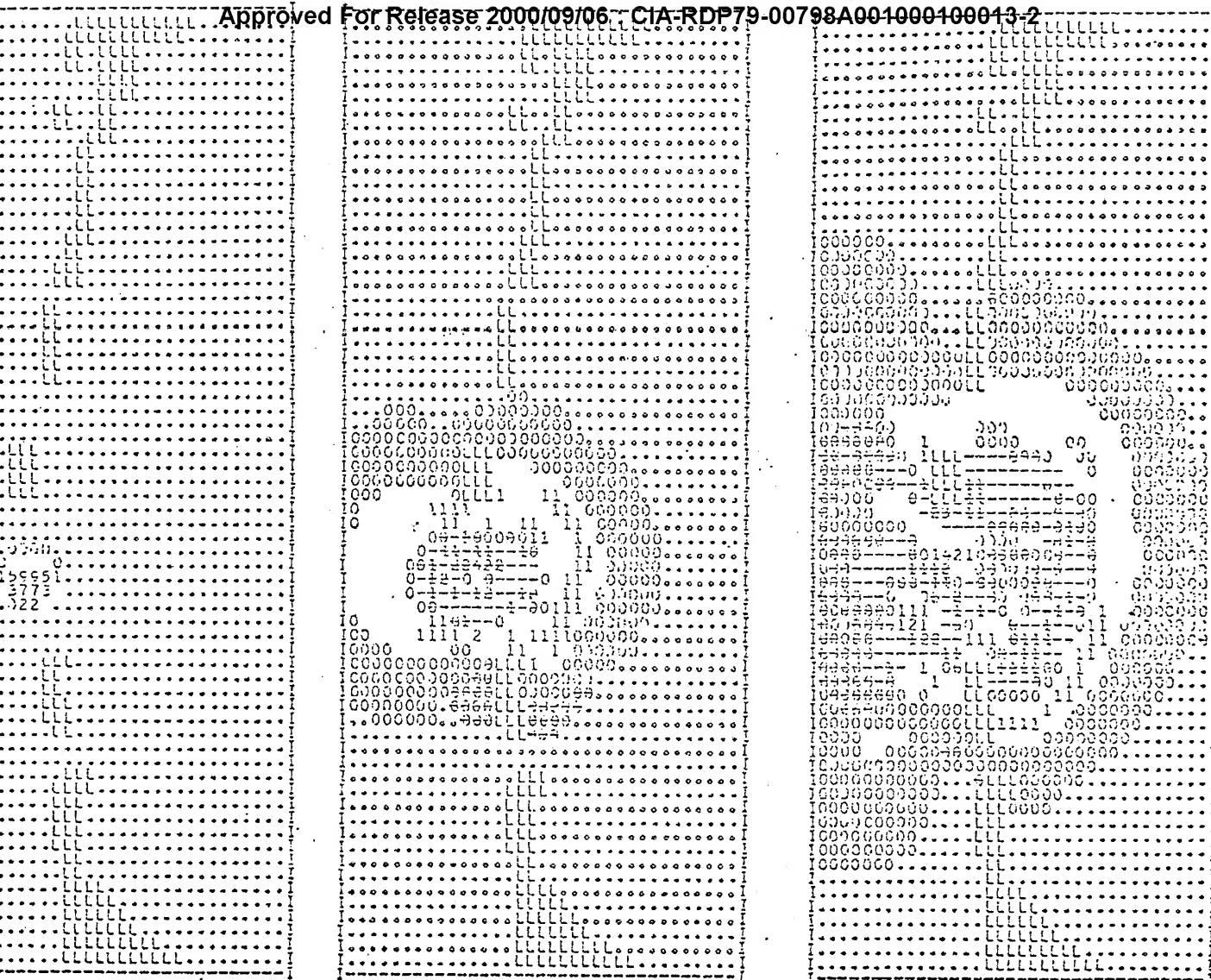


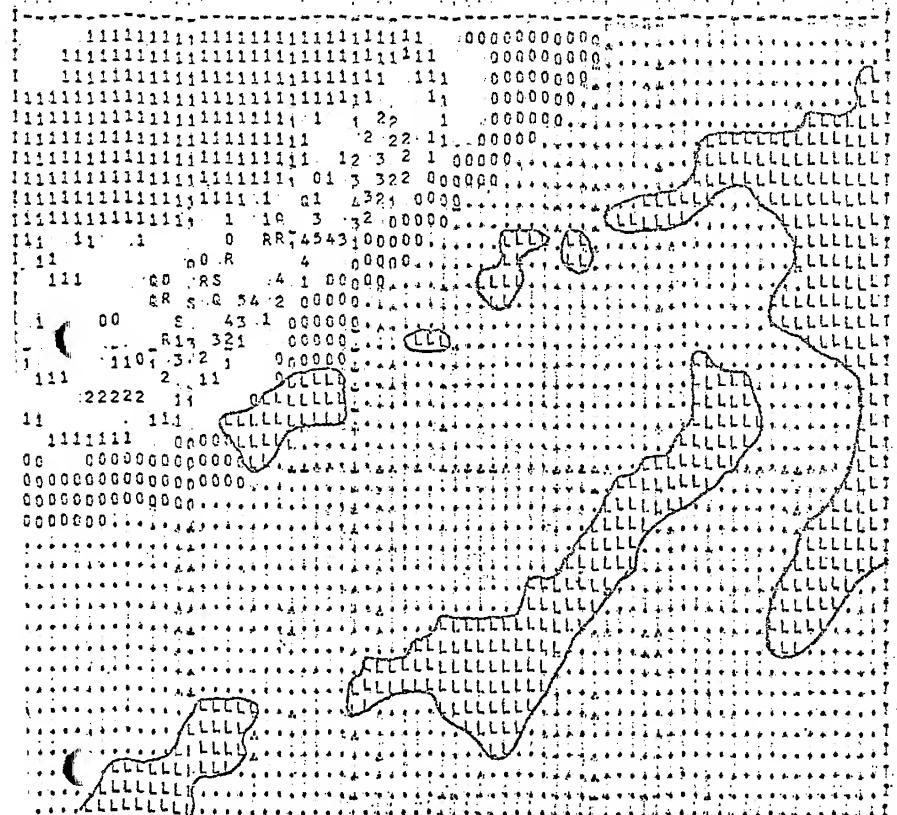
Figure 5. Computer simulation of tsunami generated by an earthquake in the central Kurils.

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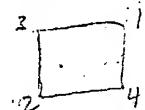
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Fig. 3,



Coordinate



1. $43^{\circ}N$, $147^{\circ}30'E$
2. $44^{\circ}40'N$, $145^{\circ}02'E$
3. $44^{\circ}45'N$, $147^{\circ}30'E$
4. $43^{\circ}N$, $145^{\circ}E$

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Itinerary - Dr. V. V. Ez

April 6, 1976	Ar. Washington, D.C. (from Moscow)	
April 7	Lv. Washington, D.C. via TWA 63 Ar. San Francisco, CA	5:40 p.m. 8:38 p.m.
April 8-19	U.S. Geological Survey, Menlo Park, CA	
April 20	Lv. San Francisco via PSA 172 Ar. Burbank, CA	8:45 a.m. 9:40 a.m.
April 20-30	California Institute of Technology Clarence R. Allen	
	University of California, Santa Barbara John C. Crowell	
April 30	Lv. Santa Barbara via UA 388 Ar. San Francisco	8:00 a.m. 8:48 a.m.
April 30-May 17	U.S. Geological Survey, Menlo Park, CA	
May 17-21	Field trip to Nevada with Robert E. Wallace	
May 22-May 31	U.S. Geological Survey, Menlo Park, CA	
May 31	Lv. San Francisco via TWA 44	10:00 p.m.
June 1	Ar. New York (Kennedy) Hotel: Algonquin Hotel 59 W. 44th Street, New York City	6:12 a.m.
June 2	Lv. New York (Kennedy) via Aeroflot 312	9:30 p.m.